



NASA STTR 2009 Phase I Solicitation

T4.01 Lidar, Radar and Passive Microwave

Lead Center: GSFC

As part of its mission, NASA needs advanced remote sensing measurements to improve the scientific understanding of the Earth, its responses to natural and human-induced changes, and to improve model predictions of climate, weather, and natural hazards. By using improved technologies in terrestrial, airborne, and spaceborne instruments, NASA seeks to better observe, analyze, and model the Earth system to aid in the scientific understanding and the possible consequences for life on Earth.

This STTR solicitation is to help provide advanced remote sensing technologies to enable future measurements. Components are sought that demonstrate a capability that is scalable to space or can be mounted on a relevant platform (Unmanned Aircraft Systems (UAS) or aircraft). New approaches, instruments, and components are sought that will:

- Enable new Earth Science measurements;
- Enhance an existing measurement capability by significantly improving the performance (spatial/temporal resolution, accuracy, range of regard); and/or
- Substantially reduce the resources (cost, mass, volume, or power) required to attain the same measurement capability.

Lidar Remote Sensing Instruments and Components

Lidar instruments and components are required to furnish remote sensing measurements for future Earth Science missions. NASA particularly needs advanced components for direct-detection lidar that can be used on new UAS platforms available to NASA, on the ground as test beds, and eventually in space. Important aspects for components are electro-optic performance, mass, power efficiency and lifetimes. Key components for direct-detection lidar (particularly efficient lasers and sensitive detectors) are solicited that enable or support the following Earth Science measurements:

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- Profiling of cloud and aerosol backscatter, with emphasis on multiple beam systems to provide horizontal coverage of relevance to the Aerosol-Clouds-Ecosystems (ACE) mission;
 - Wind measurements (using direct-detection techniques).

Radar Remote Sensing Instruments and Components

Active microwave remote sensing instruments are required for future Earth Science missions with initial concept development and science measurements on aircraft and UASs. New systems, approaches, and technologies are sought that will enable or significantly enhance the capability for: 1) tropospheric wind measurements within precipitation and clouds at X- through W-band, and 2) precipitation and cloud measurements. Systems and approaches will be considered that demonstrate a capability that can be mounted on a relevant platform (UAS or aircraft). Specific technologies include:

- High efficiency solid state power amplifiers (>5W at W-band, >20W at Ka-band and >50W at Ku-band);
- High duty cycle (~10%) power supplies and modulators for high-power Klystrons at Ka and W-band (~2 kW peak) for high-altitude (65,000 ft) operation;
- Cross track scanning Ka or W-band Doppler radar technologies with high sensitivity for clouds;
- Low sidelobe (better than -30 dB), high power phased array antennas (X, Ku, or Ka) for high-altitude operation (65,000 ft);
- High speed (output center frequency > 500 MHz), wide bandwidth (>200 MHz) adaptive versatile waveform generator for FM chirp (with amplitude modulation for ultra-low sidelobe pulse compression) generation;
- High power (>5W at W-band, >20W at Ka-band), high-speed, low loss T/R switches;
- Ultra-low sidelobe pulse compression technologies for cloud/precipitation applications.

Combined Radar and Radiometer Instruments and Components

Combined passive and active microwave remote sensing instruments are required for future Earth Science missions with initial concept development and science measurements on aircraft and, in particular, on UASs. Next-generation radar-radiometer packaging concepts are to fit into an active and passive module (1.5 -5 lb. mass allocation) at X-band, Ku-band, and Ka-band for measuring snow water equivalent to support calibration/validation activities for the Snow and Cold Land Processes (SCLP) mission. Packaging concepts are similar for L-band and C-band for measuring sea surface salinity and soil moisture in support of the Soil Moisture Active and Passive (SMAP) mission. L-band also measures sea surface temperature/roughness and thus supports "coastal" Aquarius calibration. Systems and approaches will be considered that demonstrate a capability that can be mounted on a relevant platform (in particular, UASs). Specific technologies include:

- Solid State Power Amplifier (SSPA) technology that can demonstrate ultra-high (70%) efficiency, thus enabling both low power operation for radars and thermal stability for radiometers. Design efforts should include on-wafer load-pull measurements for all frequency bands; analysis of thermal performance and comparison with present commercially available amplifiers; and design for packaged amplifiers (including efficiency, system noise parameters, and weight constraint). Each module should deliver 2W at frequency. This technology enables higher level packaging concepts for snow water equivalent (X-, Ku-, Ka-band), and

soil moisture (L-, C-band). Four modules can be combined into a 2 X 2 package on a UAS experiment.